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**Investigations of the
Carson River Mercury Site**

Nevada Bureau of Mines and Geology

MACKAY SCHOOL OF MINES

A College of Engineering and Geological Sciences



**UNIVERSITY OF NEVADA
RENO**

**Investigations of the
Carson River Mercury Site**

Proposal
submitted to the
Nevada Division of Environmental Protection
and
U. S. Environmental Protection Agency

by the
Nevada Bureau of Mines and Geology
Jonathan G. Price, Director/State Geologist
Mail Stop 178
University of Nevada, Reno
Reno, Nevada 89557-0088

(702) 784-6691

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Investigations of the Carson River Mercury Site

EXECUTIVE SUMMARY

The University of Nevada, Reno, with participation by the Desert Research Institute, proposes five tasks that address needs for characterization of the Carson River Mercury Site: (1) Determination of the Extent of Floodplain Contamination, (2) Mobility of Mercury from Tailings Piles, (3) Mineral Resource Value, (4) Natural Sources of Mercury, and (5) Other Toxic Elements.

The proposed program is divided into two phases. Phase I is a preliminary investigation designed to attack the most pressing problems and provide an understanding of the processes that have caused and are likely to continue to cause mercury dispersion along the river, its tributaries, and its floodplain. Phase I will be completed within one year at a cost to the funding agency of \$200,000. The University of Nevada System is able to share some of the costs of this project by contributing limited staff time and analytical costs: \$87,191 or 30 percent of the total project cost for Phase I.

Phase II is a more thorough investigation designed to evaluate additional issues and to more fully characterize the extent of the mercury contamination problems. Phase II will be completed within two to five years, depending on the urgency of the funding agency, at a cost to the funding agency of \$3,000,000. The University of Nevada System will be able to contribute \$268,683 or 8 percent of the total project cost for Phase II.

All investigations during Phase I and some during Phase II would fit into EPA's plans for Remedial Investigation and Feasibility Study. Most investigations during Phase II would be beyond the scope of EPA's general plans for a Remedial Investigation and Feasibility Study, but would be necessary for detailed site characterization prior to mitigation.

The University of Nevada, Reno and the Desert Research Institute have considerable expertise in the areas of analytical geochemistry, geochemistry of mercury, geochemical sampling and characterization, statistical analysis of geochemical data, geologic mapping, process geomorphology, sedimentology of rivers, hydrology, mining engineering, chemical engineering, mineral processing, and project management. Their combined knowledge of the local geological processes affecting the Carson River system is unique and should be applied to this Superfund site.

WORK PLAN OUTLINING PROPOSED STUDIES

TASK 1. DETERMINATION OF THE EXTENT OF FLOODPLAIN CONTAMINATION

Rationale

Analyses of sediment samples collected by the Nevada Bureau of Mines and Geology (NBMG) during reconnaissance of the Carson River revealed the important fact that mercury contamination is not restricted to material resting on the channel bottom (see Table 1 and Figure 1). Samples taken from the river banks also contain significant concentrations of mercury, indicating that widely distributed mercury contamination may exist within the Carson River valley. This is likely because the bank sediments were originally deposited by vertical accretion, a process that occurs during overbank flooding when river water spreads across the adjacent floodplain. Thus, mercury carried in solution and as solid particles of amalgam could be widely dispersed over the valley bottom. Plans to mitigate the mercury hazard cannot be complete until the contaminant distribution is known.

Scope of Activities - Extent of Floodplain Contamination, Phase I

Two reaches of the river, each approximately 1 mile in length, where overbank processes are most likely to occur, will be identified and characterized. One reach should be located between Dayton and Lahontan Reservoir. The second should be located near Fallon, downstream from the Lahontan Dam.

A statistically significant sampling network will be designed to determine the concentration of mercury and other elements in the surface and shallow subsurface sediment of the flood plain. Contour maps of mercury distribution will be prepared based on the results of approximately 100 samples that will be collected and analyzed in each area.

Analyses will include geochemical tests for mercury by atomic absorption spectrophotometry (with a lower detection limit of approximately 0.25 parts per million by weight) and for gold and silver by fire assay with an atomic absorption finish (with lower detection limits of 1 part per billion by weight for gold and 2.5 parts per million by weight for silver). These analyses are routinely performed in the NBMG analytical laboratory. Gold and silver fire assays account for a large portion of the laboratory's activity, because NBMG performs these analyses at a minimal fee for the public and because NBMG is a preparer of standard reference materials for gold and silver assaying.

It is important to analyze the samples not only for mercury but also for gold and silver, because precious metals can be used in conjunction with mercury analyses to distinguish between different forms of mercury in the sediments. Although most of the mercury was probably introduced into the river system as solid particles of amalgam that were not recovered during milling of the Comstock ores, our reconnaissance analyses suggest that some mercury has been dissolved from these particles and redeposited (reprecipitated or adsorbed) in the downstream reaches of the river. This hypothesis is supported by the data shown on Figure 2; low mercury-to-gold ratios in the upstream reaches are characteristic of amalgam particles, whereas high ratios in the downstream reaches suggest mercury dissolution and redeposition. If the downstream mercury were dominantly in amalgam particles, one would expect the mercury-to-gold ratios to

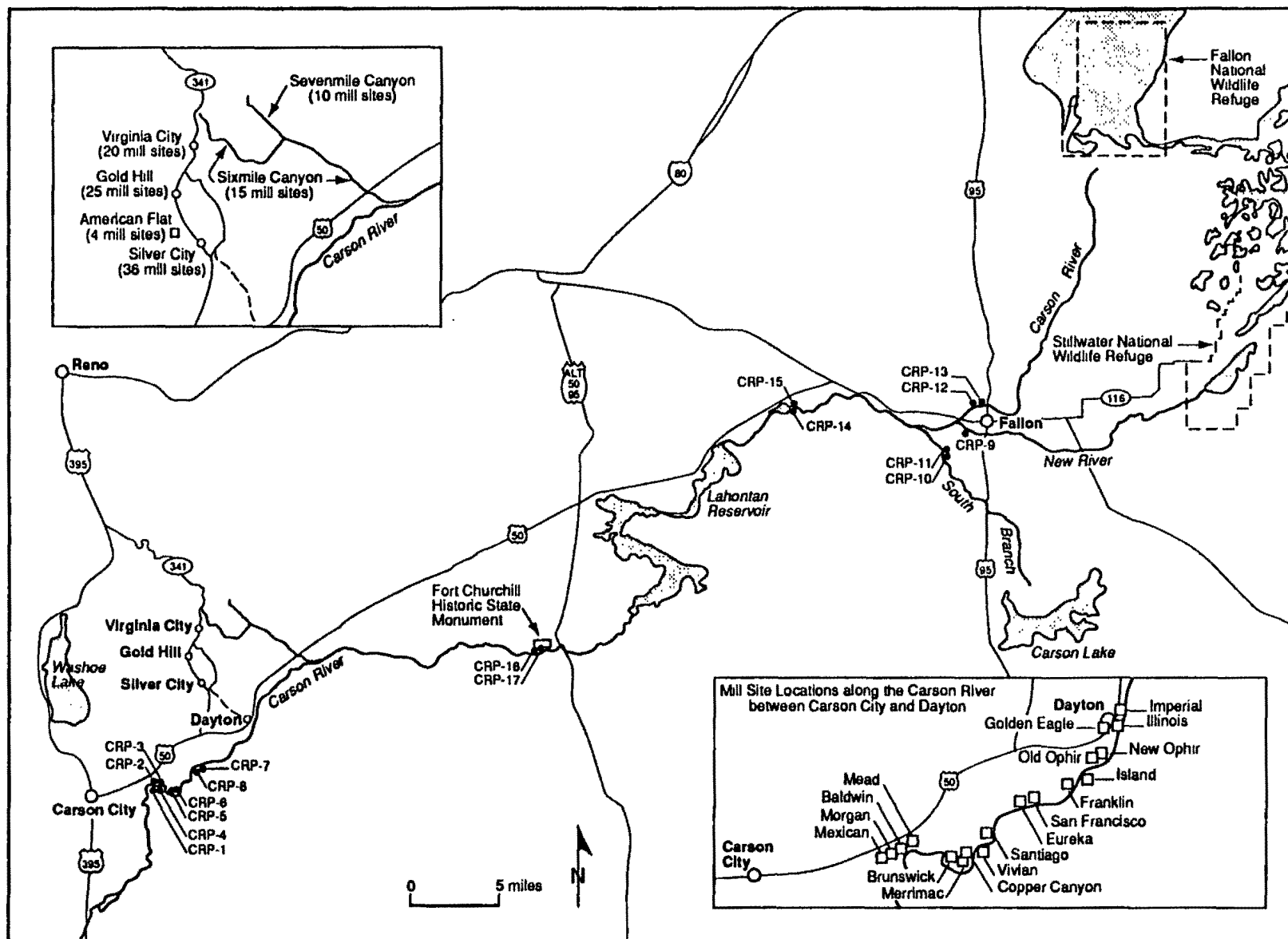


Figure 1. Locations of Comstock-era mills and sample sites along the Carson River

Table 1. Preliminary results of analyses by the Nevada Bureau of Mines and Geology on samples from the Carson River area.

Sample No.	Ag (ppm)	Au (ppb)	Hg (ppm)	Sample Type	Location	Hg/Au	Relative downstream position
CRP-1	<2.5	29	1.0	overbank	C-D	34	1
CRP-2	<2.5	11	0.5	fill	C-D	45	2
CRP-3	16.0	770	132.0	overbank-FeOx	C-D	171	3
CRP-4	<2.5	46	0.5	stream sed.	C-D	11	4
CRP-5	<2.5	18	0.4	stream sed.	C-D	22	5
CRP-6	14.0	2700	22.0	overbank	C-D	8	6
CRP-7	<2.5	49	2.7	overbank	C-D	55	8
CRP-8	<2.5	48	0.8	stream sed.	C-D	17	7
CRP-9	<2.5	12	1.8	stream sed.	L-F	150	15
CRP-10	2.5	48	15.0	stream sed.	L-F	313	14
CRP-11	2.5	70	17.0	overbank	L-F	243	13
CRP-12	<2.5	17	1.8	stream sed.	L-F	106	16
CRP-13	<2.5	13	2.3	overbank	L-F	177	17
CRP-14	3.0	40	6.7	overbank	L-F	168	11
CRP-15	<2.5	18	2.0	stream sed.	L-F	111	12
CRP-16	4.2	120	9.2	stream sed.	D-L	77	9
CRP-17	12.0	200	15.0	overbank-FeOx	D-L	75	10
Typical background	0.2	10	0.5				

See Figure 1 for sample locations (C = Carson City; D = Dayton; L = Lahontan Reservoir; F = Fallon).

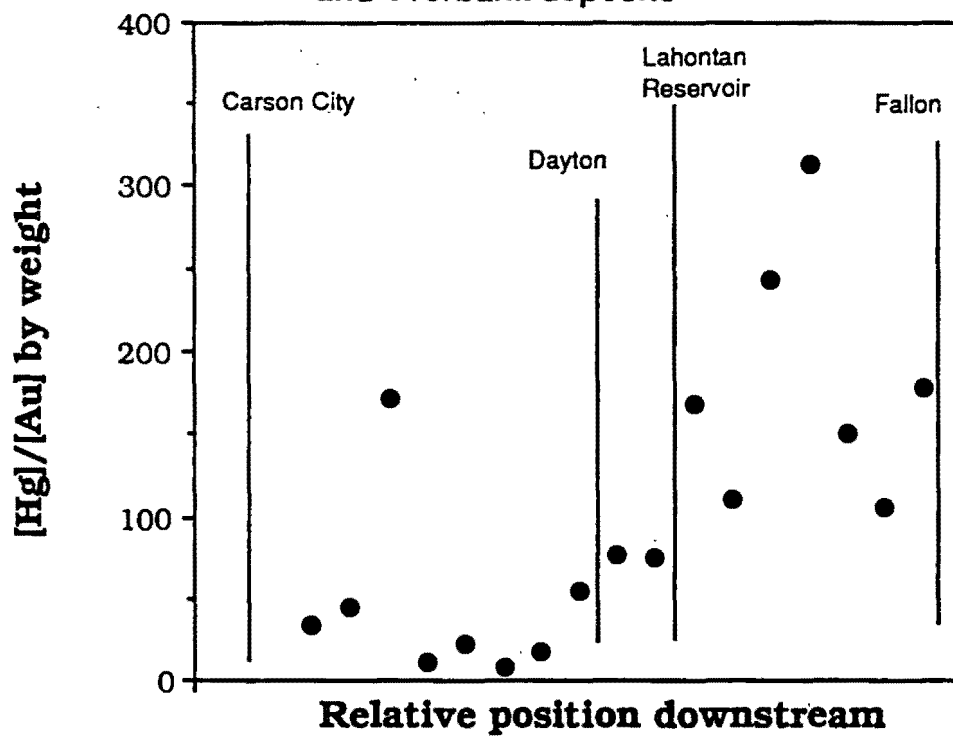
Sample types include overbank deposits collected within 25 meters of the river's edge, overbank deposits with pronounced iron oxide contents (suggestive of a significant detrital component from tailings piles or mine dumps), and stream sediments from the riverbed itself.

Analyses were performed by the following techniques: Hg by atomic absorption spectrophotometry (with a lower detection limit of approximately 0.25 ppm), Au and Ag by fire assay with an atomic absorption finish (lower detection limits of 1 ppb Au and 2.5 ppm Ag).

Typical background values are on the order of 0.2 ppm Ag, 10 ppb Au, and 0.5 ppm Hg.

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**Figure 2. Ratio of mercury to gold
in Carson River sediments
and overbank deposits**



Source: Nevada Bureau of Mines and Geology

be much lower, because gold is much less soluble than mercury in river water or ground water. Knowledge of the form of the mercury, as solid amalgam particles or as ultrafine-grained precipitates or mercury adsorbed on mineral grains and organic material, will be critical to many engineering designs for mitigation.

The geochemical data will be supplemented with in-situ analyses of mercury in soil gas. In addition, particle-size analyses (1/2-phi intervals) will be conducted to ascertain whether mercury concentrations are related to size distribution. Examination of a selected set of samples by scanning electron microscopy will be performed to further determine the form of the mercury in the sediments.

Subareas (perhaps 20 acres) of high mercury concentrations revealed by the initial surveys will be located in both major reaches. These will be studied in greater detail to determine the processes involved in the mercury emplacement. In these zones, detailed mapping of the floodplain surface and channel margins will help to define how flood waters are delivered to the floodplain surface. Overbank flow often occurs simultaneously along the entire river margin. This flow normally covers the entire floodplain as a slowly moving sheet. It is possible, however, that water is introduced onto the floodplain through low sags in the channel margins and traverses the flood plain in minor channels. In such cases, contamination from flood water would be localized in and near the shallow linear channels on the floodplain surface.

A limited number of new samples (approximately 20) will be collected within each subarea. Their precise location will be guided by the results of detailed topographic surveying and in-situ analyses of mercury in soil gas. Some samples will be collected at a shallow depth beneath the surface where high concentrations of mercury have been found. These will provide insight as to whether mercury is being mobilized at the surface by dissolution and carried downward by percolation into the vadose zone where reprecipitation of mercury may occur.

Scope of Activities - Extent of Floodplain Contamination, Phase II

The results of Phase I will be used to design a sampling program to fully characterize the extent of mercury contamination within the floodplain. These data plus new data on mercury in the channel bottom, in tributaries, remaining in tailings piles, and in far downstream reaches of the river system will be integrated with historic data on mercury consumption at the mills to perform mass-balance calculations that will indicate where most of the mercury resides. The extent of ground-water contamination by mercury will also be investigated as part of Phase II. Ground-water investigations will draw upon data collected by the U.S. Geological Survey as part of the National Water-Quality Assessment Program.

Phase II will also include more detailed characterization of the form of the mercury in the sediments. Mitigation strategies may be drastically different if significant amounts of mercury are adsorbed on mineral grains or organic matter, rather than occurring as relatively coarse amalgam grains. Detailed characterization will include not only more chemical analyses but also more scanning electron microscopy.

Phase II will include engineering evaluation of alternative mitigation strategies. Physical approaches from lining the channel of the river to excavation, dredging, gravity separation of amalgam, and waste disposal need to be investigated, as do possible chemical treatments of the sediments to remove

mercury, gold, and silver and to stabilize the waste. The evaluation will take into account short-term harm due to disturbance of the river system during mitigation, which, upon final analysis, could outweigh the long-term benefits of certain mitigation strategies.

TASK 2. MOBILITY OF MERCURY FROM TAILINGS PILES

Rationale

The characterization of mercury distribution on the floodplain and within the river channel is critical to any plan for hazard mitigation. Remedial action based only on the results of those studies, however, assumes that most, if not all, of the contamination is already in place. The fact is that old mill tailings still contain significant amounts of mercury. Thus, continued release of mercury from tailings represents a potential source of mercury replenishment to the river system. Failure to consider this source may negate much of the environmental benefit achieved through remedial action taken along the river channel and on the floodplain. Mercury mobilized from tailings may simply replace that removed or isolated from the accessible environment by hazard mitigation, such that the problem may return within a period of time. Clearly, it is important to know how much mercury remains in the tailings, whether it can be or has been mobilized, and, if so, under what conditions and in what amounts.

Scope of Activities - Mobility of Mercury from Tailings Piles, Phase I

Tailings should be systematically sampled in two major areas (Carson City-Dayton and Virginia City-Sixmile Canyon) to determine the level of mercury contained in the piles. Mass-balance calculations should be undertaken to evaluate whether the tailings represent a potentially dangerous source in the future. We estimate that approximately 100 samples will be needed in this initial investigation. Sampling will be guided by historic research and by in-situ measurements of mercury. The same analytical procedures will be followed as proposed for the floodplain characterization.

In addition to analyses of mill tailings, channel samples from two areas draining the tailings areas will be sampled and analyzed. One channel study area will be located in the channel of the Carson River between Carson City and Dayton, where high energy fluvial conditions exist and tailings piles are near the present river. A second channel study area will be located in Sixmile Canyon, which serves as a major drainage pathway from the Virginia City region and is a tributary to the Carson River.

Bulk samples will be collected from the river and stream channels to determine if amalgam has been transported from the tailing piles. Heavy sediment, including amalgam, usually accumulates in placer deposits, and therefore the procedures will require experience in bulk sampling for placer evaluation. Although University geologists and mining engineers have expertise to oversee this sampling, we expect to subcontract this portion of the project to a recognized consultant in this field. Care will be taken to minimize introducing suspended sediment into the river during this sampling. It is anticipated that no more than 20 bulk samples will be needed, but as many as four splits of each sample will be chemically analyzed.

Estimating the height and breadth of the Carson River during major floods is critical to evaluating the risk of tailings debris being mobilized by the river itself. Depending on the vertical distance of tailings piles above the present river, the height attained during major flow may periodically introduce more amalgam into the river system. Maximum stage during historic floods can be estimated by combining U. S. Geological Survey gage-station records with precise surveying of the cross-valley configuration at the position of the tailings pile.

Estimating maximum height during floods on ungaged rivers is more complicated. We suggest that a preliminary study involving dendroclimatology may give rough estimates of the discharge during any year. This technique is based on the fact that tree-ring widths are related to the amount of annual precipitation; wide rings indicating high precipitation. Comparison of tree rings at various localities with actual discharge measurements and precipitation station records would allow correlation of ring width to precipitation and discharge. In essence we could extend the paleohydrologic records backwards into the period before direct measurement. The frequency and magnitude of major water years could then be determined. A cautionary note is that the rings reveal annual precipitation and not the magnitude of any given storm during the year. Thus, rings yield proxy data that may not be precisely related to maximum stage, but they might provide educated approximations as to how often major floods (for example, as in 1986) can be expected.

It is important to know what fluvial conditions are needed to entrain and transport amalgam particles downstream. The flow conditions needed to induce motion of the largest amalgam particles can be determined by standard computations of critical tractive force and critical stream power. Whether critical conditions are attained and how often can be estimated from available gage-station records on the Carson River.

Analysis in Sixmile Canyon will be more difficult, but tractive force can be estimated using flood-height data as a critical depth parameter. The frequency factor, however, will depend on proxy data, as explained above.

Scope of Activities - Mobility of Mercury from Tailings Piles, Phase II

The Phase I investigations of mobility of mercury from tailings piles will provide an initial evaluation of the potential problem that these piles pose. If the potential is high for mercury to be mobilized from the tailings piles and enter the river system, then Phase II investigations will be needed to more precisely characterize the individual piles and to more accurately predict the effects of future floods on individual piles.

Phase II will also include engineering evaluation of alternative mitigation strategies for the high-mercury tailings piles. Physical approaches to isolating the tailings from erosion and to removing mercury from the piles will be investigated.

TASK 3. MINERAL RESOURCE VALUE

Rationale

The potential for recovery of gold and silver from amalgam particles should be seriously considered. Some samples within the preliminary set analyzed by NBMG are clearly high enough in gold and silver concentration to justify evaluation (see Figure 3). The funds produced from the recovery of gold and silver could defray a portion of the costs of the overall cleanup.

The volumes of riverbed and floodplain material are enough to warrant collecting data needed for an economic feasibility study. For example, assuming an average thickness of approximately 5 feet and an average width of 100 feet, approximately 7 million tons of sediment are in a 50-mile stretch of the riverbed. Overbank deposits on the floodplain could be several times more than this figure.

The amalgam in the river system is likely to change in its metallic ratios from place to place and with time, as suggested by Figure 2. Processes of oxidation and aqueous complexing may alter the ratios, such that detailed characterization is needed to determine the economic viability of recovering gold and silver.

Preliminary analyses suggest that the value of gold contained in the river and overbank sediments may be on the order of \$0.25 to \$1 per ton and that high-grade pockets are likely to be encountered. Today in Nevada, ores with gold values as low as \$3 per ton are being profitably mined, crushed, and processed. Silver values may also be significant, at least in some stretches of the river. The Comstock Lode was a major silver producer, but at today's prices most of the value in the amalgam is likely to be gold.

Perhaps more important than gold or silver from an economic standpoint is the value of sand and gravel. Sand and gravel for the Reno-Carson City market currently sells for approximately \$4.50 per ton, and is used primarily for highway and building construction. It is possible that much of the material that could be cleaned up from the river could be usable as construction aggregate, at least for highways.

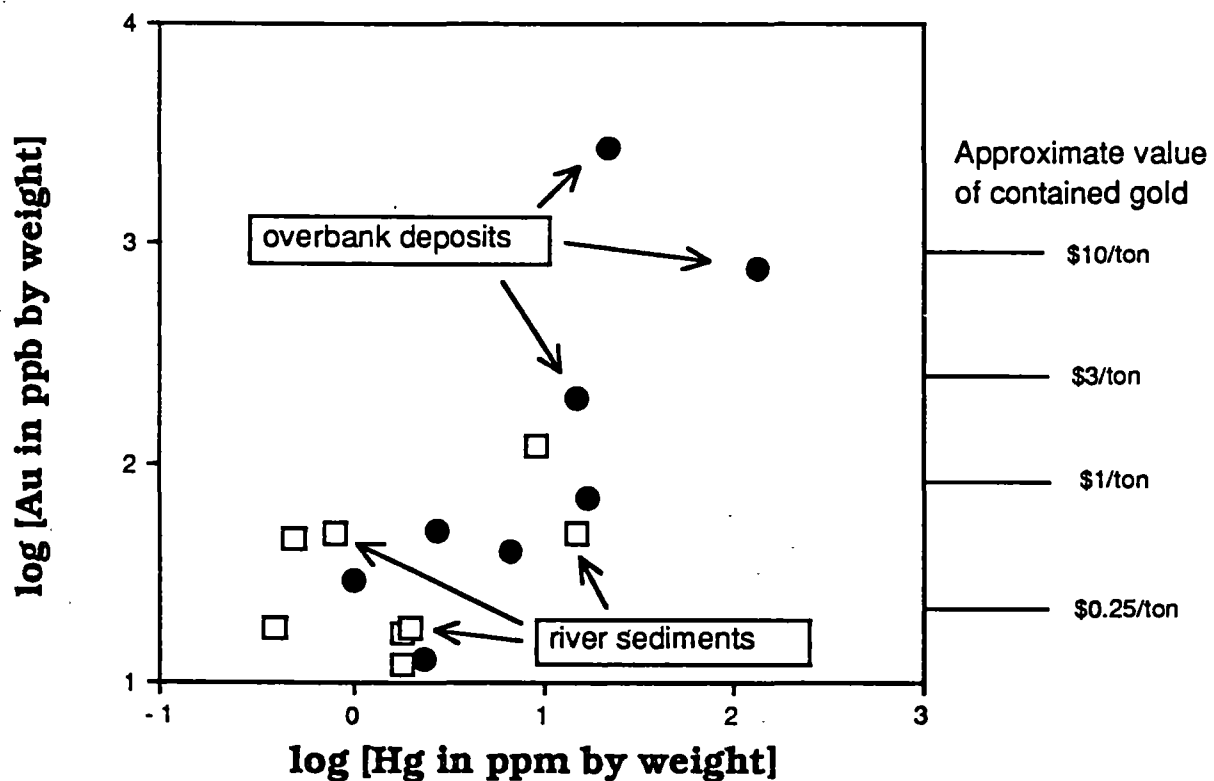
Scope of Activities - Mineral Resource Value, Phase I

Phase I activities to evaluate mineral resources will be limited to interpretation of the data on gold, silver, and particle size distribution collected in Tasks 1 and 2. In total, approximately 360 samples of floodplain sediments, channel placers, and tailings piles will be analyzed for gold and silver in Tasks 1 and 2.

Scope of Activities - Mineral Resource Value, Phase II

If the results of Phase I indicate a strong potential for recovery of gold, silver, or construction aggregate, then additional sampling will be required for a full economic feasibility study. The feasibility study will be the major accomplishment of Phase II for this task. The feasibility study will be done under subcontract by a consulting firm with expertise in placer evaluation.

Figure 3.
Gold and mercury in Carson River sediments
and overbank deposits



Source: Nevada Bureau of Mines and Geology

TASK 4. NATURAL SOURCES OF MERCURY

Rationale

Natural areas of mercury concentrations are abundant in Nevada, and some are known in the drainage area of the Carson River, including the immediate vicinity of Lahonton Reservoir. Although the contribution of mercury from natural sources is likely to be considerably less than that from mining on the Comstock Lode, the natural sources should be investigated. Standard techniques of geologic mapping, alteration mapping (with the help of remote sensing), and geochemical sampling should be able to identify most areas of large-scale hydrothermal alteration and mercury concentration. Active geothermal systems, which are abundant in western Nevada, could be additional natural sources of mercury and will be investigated along with the areas of hydrothermal alteration. Further geochemical investigations should be able to determine the likelihood of the natural sources contributing to the elevated concentrations of mercury in the river system.

Scope of Activities - Natural Sources of Mercury, Phase I

Because most of the natural mercury is probably in the form of cinnabar, mercury sulfide, or other relatively insoluble mercury minerals, it is unlikely that natural sources of mercury are significant contributors to the problem of mercury in the river system. Therefore all investigations of natural sources will be limited to Phase II.

Scope of Activities - Natural Sources of Mercury, Phase II

Phase II activities will include geochemical sampling and characterization of all major outcropping areas of hydrothermal alteration within the drainage area of the Carson River system. Remote sensing techniques will supplement conventional geologic and alteration mapping to identify alteration areas not already known from previous studies. Analytical and quality assurance procedures established for the NBMG Geochemical Sampling and Characterization Program, which began in 1990, will be used in this task. It is estimated that approximately 150 samples will be sufficient to accomplish this task.

TASK 5. OTHER TOXIC ELEMENTS

Rationale

The Comstock ores contained minerals with elevated concentrations of arsenic and lead and, most likely, other toxic elements. These types of ores are occasionally enriched in thallium. Selected samples that are collected as part of the characterization of the extent of mercury contamination should be analyzed for a suite of elements that are likely to have come from the Comstock ores and mill tailings.

Scope of Activities - Other Toxic Elements, Phase I

Approximately 360 samples will have been analyzed for mercury, gold, and silver as parts of Tasks 1 and 2. Arsenic, thallium, and lead will be analyzed in all samples containing highly anomalous amounts of mercury, gold, or silver. Typical background values are on the order of 0.5 parts per million for mercury, 10 parts per billion for gold, and 0.2 parts per million for silver. Amounts in excess of ten times these background values will be considered highly anomalous. Approximately 25 selected highly anomalous samples as well as selected background-level samples will be analyzed for a broad suite of elements. Analytical and quality assurance procedures established for the NBMG Geochemical Sampling and Characterization Program will be used in this task.

Scope of Activities - Other Toxic Elements, Phase II

Depending on the results of the analyses in Phase I, additional samples collected during Phase II for other tasks will be analyzed for those elements that pose an environmental threat.

If additional environmental problems from other elements are recognized, then Phase II will also include engineering evaluations of alternative mitigation strategies. These evaluations are likely to be minor additions to evaluations performed for Tasks 1 and 2. For example, it is likely that physical approaches to isolating tailings piles from erosion will solve not only some of the mercury problems but also potential problems of adding lead, arsenic, or other toxic elements to the river system from these sources.

PROJECT COORDINATION AND QUALIFICATIONS OF THE INVESTIGATORS

The project will be coordinated and managed by NBMG. NBMG is the state geological survey and is a research unit of the Mackay School of Mines at the University of Nevada, Reno. Other participants from the Mackay School of Mines include researchers from the Departments of Geological Sciences, Mining Engineering, and Chemical and Metallurgical Engineering. The Desert Research Institute (DRI), like the University of Nevada, Reno, is part of the University of Nevada System. DRI is a major contract research organization with broad expertise that has been applied to various problems involving weather, hydrology, and active geological processes. In particular, DRI programs in Water Resources and Quaternary Science are well known. Both NBMG and DRI have conducted research projects involving quality assurance procedures approved by the U.S. Environmental Protection Agency.

A list of organizations and individuals that may be involved in this project is given in Table 2. Complete resumes of individuals can be supplied upon request.

The University of Nevada, Reno and the Desert Research Institute together have considerable expertise in the areas of analytical geochemistry, geochemistry of mercury, geochemical sampling and characterization, statistical analysis of geochemical data, geologic mapping, process geomorphology, sedimentology of rivers, hydrology, mining engineering, chemical engineering, mineral processing, and project management. Their combined knowledge of the local geological processes affecting the Carson River system is unique and should be applied to the Superfund site.

Efforts will be made throughout this project to coordinate University of Nevada System activities with those of other research organizations who may be addressing some aspects of the issues. Duplication of work will be avoided. Specifically, we will keep in touch with and seek advice from the Nevada District Office of the U.S. Geological Survey, which has been conducting an investigation of the ground-water quality of the Carson River basin as part of the National Water-Quality Assessment Program, and the Reno Research Center of the U.S. Bureau of Mines, which is investigating certain chemical approaches to mercury hazard mitigation. We also will seek advice from local technical experts, in particular James J. Cooper, Aquatic Biologist with the Nevada Division of Environmental Protection, who has authored landmark studies of the biological issues involving mercury contamination in the river system.

Table 2. Organizations and individuals that may be involved in investigations of the Carson River Mercury Site

State of Nevada - University of Nevada System

University of Nevada, Reno - Mackay School of Mines

Nevada Bureau of Mines and Geology (the state geological survey)

Paul J. Lechler, M.S., Chief Chemist/Geochemist (sampling and analysis of sediments and soils for mercury, gold, and silver)

Mario Desilets, B.S., Assistant Chemist and Quality Assurance Officer (sampling and analysis, oversight of selected analyses performed by other laboratories, quality assurance and quality control)

Stephen B. Castor, Ph.D., Research Geologist (sampling and interpretation of analyses; natural sources of mercury; evaluation of sand and gravel)

Jonathan G. Price, Ph.D., Director/State Geologist (project management and advice on geochemistry and general geology)

Department of Geological Sciences

James Carr, Ph.D., Associate Professor of Geological Engineering (design of sampling program and geostatistical interpretation of results; remote sensing)

Frank Dickson, Ph.D., Professor of Geology (sampling and analysis design, assistance with project management, interpretation of analyses, advise on mercury geochemistry and speciation)

Berry Lyons, Ph.D., Director, Hydrology and Hydrogeology Program (sampling and analysis design, interpretation of analyses, advise on mercury geochemistry)

Martin Jensen, M.S., Research Associate (evaluations of samples using a scanning electron microscope with energy dispersive spectrometer)

Graduate Research Assistants in Geological Sciences, Hydrogeology, Remote Sensing, and/or Geological Engineering

Department of Chemical and Metallurgical Engineering - engineering evaluation of remediation strategies involving chemical processing (Phase II)

Department of Mining Engineering - engineering evaluation of remediation strategies involving geotechnical and mining practices (Phase II)

Desert Research Institute

Dale F. Ritter, Ph.D., Executive Director, Quaternary Sciences Center (geomorphology and sedimentation in river systems)

Jonathan O. Davis, Ph.D., Research Professor (geomorphology; sedimentation)

Roger L. Jacobson, Ph.D., Associate Research Professor (hydrology, both shallow groundwater and surface water)

Jerry R. Miller, Ph.D., Assistant Research Professor (fluvial and soils geomorphology)

Onstream Resource Managers, Inc. (subcontractor)

Ellen F. Hodos, P.E., M.S., Vice President, Mining Engineer and Geologist (placer sampling and evaluation, experience in developing economic models for EPA's Placer Mine Effluent Regulations)

James J. Hodos, B.A., President, Geologist and Environmental Assessor (placer mining and reclamation planning)

DELIVERABLES

Phase I will be completed within one year. A contract report will be prepared during the fourth quarter and will include the results of all analyses, maps showing sample locations, and interpretations of the analyses. The report will be divided into sections according to the tasks outlined above: Task 1 (Determination of the Extent of Floodplain Contamination), Task 2 (Mobility of Mercury from Tailings Piles), Task 3 (Mineral Resource Value), and Task 5 (Other Toxic Elements). No work will be done on Task 4 (Natural Sources of Mercury) until Phase II.

In addition to the contract report, the results of the investigations during Phase I will be published as either a peer-reviewed report or bulletin of the Nevada Bureau of Mines and Geology. These reports are widely distributed to major geological libraries throughout the world. In addition, certain aspects of the investigations are likely to lead to spin-off publications in internationally recognized scientific journals.

Phase II will be completed within two to five years, depending on the needs and urgency of the funding agency. Phase II should begin after Phase I but could begin earlier if necessary. Annual contract reports, divided into sections according to the five tasks, will update results of analyses, maps of sample locations, and interpretations. The last annual report will summarize all results and serve as a final contract report. Results of the overall investigation will be published as a peer-reviewed bulletin of the Nevada Bureau of Mines and Geology, and at least five spin-off publications in scientific journals are likely to be produced.

TECHNOLOGY TRANSFER

The results of these investigations in the Carson River system will be transferable to other sites where cleanup of mercury is needed. Such sites include other mining areas in the western United States and elsewhere in the world, as well as government installations (such as Oak Ridge, Tennessee) and industrial sites that are or may become Superfund sites. Publication of results in Nevada Bureau of Mines and Geology reports and bulletins and in scientific journals will assure wide availability to potential users.

TIME SCHEDULES

Time schedules with project milestones are listed in Tables 3 and 4 for Phases I and II, respectively. Sampling in the middle of the winter is impractical and may be impossible if unusually deep snow covers the area. Ideally, Phase I would begin March 1, 1991. The majority of sampling of the main areas then would be completed by the end of August (Month 6 in Table 2), and sampling of subareas would be completed by the end of November (Month 9 in Table 2).

Table 3. Milestones for Phase I.

Task 1 (Determination of the Extent of Floodplain Contamination)

Select main sampling areas
 Finish mapping and sampling
 Finish chemical analyses
 Finish particle-size analyses
 Select subareas for sampling
 Finish mapping and sampling
 Finish chemical analyses
 Finish particle-size analyses
 Complete contract report

Month												
1	2	3	4	5	6	7	8	9	10	11	12	
X												
			X									
					X							
					X							
						X						
								X				
									X			
									X			
											X	

Task 2 (Mobility of Mercury from Tailings Piles)

Select sampling areas
 Finish mapping and sampling
 Finish chemical analyses
 Finish particle-size analyses
 Evaluate gage-station records
 Complete dendroclimatology study
 Complete contract report

X												
					X							
							X					
							X					
					X							
									X			
											X	

Task 3 (Mineral Resource Value)

Interpret data from Tasks 1 & 2
 Complete contract report

								X				
											X	

Task 5 (Other Toxic Elements)

Select samples for analysis
 Finish chemical analyses
 Complete contract report

								X				
										X		
											X	

Table 4. Milestones for Phase II (assuming a three-year schedule).

	Year/Quarter											
	Year 1				Year 2				Year 3			
	1	2	3	4	1	2	3	4	1	2	3	4
Task 1 (Determination of the Extent of Floodplain Contamination)												
Select sampling areas	X											
Finish mapping & sampling		X				X				X		
Finish chemical analyses			X				X				X	
Finish particle-size analyses			X				X				X	
Initiate engineering studies	X											
Complete engineering studies										X		
Complete annual report				X				X				X
Task 2 (Mobility of Mercury from Tailings Piles)												
Select sampling areas	X											
Finish mapping and sampling		X				X				X		
Finish chemical analyses			X				X				X	
Finish particle-size analyses			X				X				X	
Refine flow calculations									X			
Initiate engineering studies	X											
Complete engineering studies										X		
Complete annual report				X				X				X
Task 3 (Mineral Resource Value)												
Select sampling areas	X											
Finish sampling for year		X				X				X		
Finish chemical analyses			X				X				X	
Finish particle-size analyses			X				X				X	
Complete feasibility study										X		
Complete annual report				X				X				X
Task 4 (Natural Sources of Mercury)												
Select sampling areas	X											
Finish sampling for year		X				X				X		
Finish chemical analyses			X				X				X	
Complete annual report				X				X				X
Task 5 (Other Toxic Elements)												
Select samples for analysis			X									
Finish chemical analyses				X				X				X
Initiate engineering studies	X											
Complete engineering studies										X		
Complete annual report				X				X				X

BUDGETS

Budget pages for Phases I and II are attached. These are broken down into standard cost categories for EPA grants and into budgets for individual tasks. No equipment purchases or construction are planned for either phase of the investigations.

Please note that the Nevada Bureau of Mines and Geology is able to share some of the costs of this project by contributing limited staff time and that DRI will contribute the costs of some particle-size determinations. The commitments on the part of the University of Nevada System are \$87,191 or 30 percent of the total project cost for Phase I and \$268,683 or 8 percent of the total project cost for Phase II.

Budget, Phase I: Investigations of the Carson River Mercury Site (by Major Cost Categories)

	Superfund	University	TOTAL
PERSONNEL			
Professional Staff - regular contracts		15,833	15,833
Professional Staff - summer contracts	23,361		23,361
Classified Staff	4,709	27,946	32,655
Research Assistants	19,056		19,056
SUBTOTAL, PERSONNEL	47,126	43,779	90,905
FRINGE BENEFITS			
18% of regular professional salaries		2,850	2,850
3% of summer professional salaries	701		701
30% of classified staff salaries	1,413	8,384	9,797
1.2% of research assistant wages	229		229
SUBTOTAL, FRINGE BENEFITS	2,343	11,234	13,577
TRAVEL			
Vehicle rental (4 months @ \$220)	880		880
Vehicle mileage (5,000 miles @ \$0.27)	1,350		1,350
Per diem (lunch only, 120 person days @ \$6)	720		720
Out-of-State Travel to EPA-Region 9	500		500
SUBTOTAL, TRAVEL	3,450	0	3,450
SUPPLIES			
Field supplies for sampling and in-situ Hg measurements	3,972		3,972
Office supplies	2,000		2,000
SUBTOTAL, FIELD SUPPLIES	5,972	0	5,972
CONTRACTUAL			
Subcontract with Desert Research Institute	61,000		61,000
Subcontract with placer-sampling experts	10,000		10,000
SUBTOTAL, CONTRACTUAL	71,000	0	71,000
OTHER EXPENSES			
Chemical analyses			
420 Hg+Au+Ag @ \$17	7,140		7,140
180 Pb+As+TI @ \$21	3,780		3,780
25 full inorganic analyses @ \$120	3,000		3,000
Scanning electron microscopy (20 hr @ \$150)	3,000		3,000
260 particle-size analyses @ \$15 (contributed by DRI)		3,900	3,900
SUBTOTAL, OTHER EXPENSES	16,920	3,900	20,820
TOTAL DIRECT CHARGES	146,811	58,913	205,724
INDIRECT COSTS (48% of total direct costs less equipment and amounts of subcontracts in excess of \$25,000)	53,189	28,278	81,467
TOTAL	200,000	87,191	287,191

Budget, Phase I: Investigations of the Carson River Mercury Site (by Task)

	Superfund	University	TOTAL
Task 1. Determination of the Extent of Floodplain Contamination	94,000	40,980	134,980
Task 2. Mobility of Mercury from Tailings Piles	72,000	31,389	103,389
Task 3. Mineral Resource Value	14,000	6,103	20,103
Task 4. Natural Sources of Mercury - no activity until Phase II	0	0	0
Task 5. Other Toxic Elements	20,000	8,719	28,719
TOTAL	200,000	87,191	287,191

Budget, Phase II: Investigations of the Carson River Mercury Site (by Major Cost Categories)

	Superfund	University	TOTAL
PERSONNEL			
Professional Staff - regular contracts	150,000	52,248	202,248
Professional Staff - summer contracts	407,582		407,582
Classified Staff	195,539	92,223	287,762
Research Assistants	494,885		494,885
SUBTOTAL, PERSONNEL	1,248,006	144,471	1,392,477
FRINGE BENEFITS			
18% of regular professional salaries	27,000	9,405	36,405
3% of summer professional salaries	12,227		12,227
30% of classified staff salaries	58,662	27,667	86,329
1.2% of research assistant wages	5,939		5,939
SUBTOTAL, FRINGE BENEFITS	103,828	37,072	140,900
TRAVEL			
Vehicle rental (72 months @ \$220)	15,840		15,840
Vehicle mileage (72,000 miles @ \$0.27)	19,440		19,440
Per diem (lunch only, 2,000 person days @ \$6)	12,000		12,000
Out-of-State Travel to EPA-Region 9 and other meetings	10,000		10,000
SUBTOTAL, TRAVEL	57,280	0	57,280
SUPPLIES			
Field supplies for sampling and in-situ Hg measurements	19,983		19,983
Office supplies	15,000		15,000
SUBTOTAL, FIELD SUPPLIES	34,983	0	34,983
CONTRACTUAL			
Subcontract with Desert Research Institute	450,000		450,000
Subcontract with placer-sampling experts	125,000		125,000
SUBTOTAL, CONTRACTUAL	575,000	0	575,000
OTHER EXPENSES			
Chemical analyses			
6000 Hg+Au+Ag @ \$17	102,000		102,000
400 Pb+As+Tl @ \$21	8,400		8,400
190 full inorganic analyses @ \$120	22,800		22,800
Scanning electron microscopy (200 hr @ \$150)	30,000		30,000
1000 particle-size analyses @ \$15	15,000		15,000
SUBTOTAL, OTHER EXPENSES	178,200	0	178,200
TOTAL DIRECT CHARGES	2,197,297	181,543	2,378,840
INDIRECT COSTS (48% of total direct costs less equipment and amounts of subcontracts in excess of \$25,000)	802,703	87,140	889,843
TOTAL	3,000,000	268,683	3,268,683

Budget, Phase II: Investigations of the Carson River Mercury Site (by Task)

	Superfund	University	TOTAL
Task 1. Determination of the Extent of Floodplain Contamination	1,832,061	164,082	1,996,143
Task 2. Mobility of Mercury from Tailings Piles	687,023	61,530	748,553
Task 3. Mineral Resource Value	229,008	20,510	249,518
Task 4. Natural Sources of Mercury - no activity until Phase II	68,702	6,153	74,855
Task 5. Other Toxic Elements	183,206	16,408	199,614
TOTAL	3,000,000	268,683	3,268,683



UNIVERSITY OF NEVADA-RENO

Joseph N. Crowley
President

Reno, Nevada 89557-0061
(702) 784-4805

March 9, 1989

TO: Faculty and Staff
FROM: Joe Crowley *Joe Crowley*
SUBJECT: A Drug-free Workplace

On October 21, 1988, Congress passed the Omnibus Anti-Drug Abuse Act of 1988 (referred to hereafter as the Act), which contained the House and Senate compromise provisions of H.R. 5210. The Act requires that recipients of federal funds provide a drug-free workplace.

The following policy/information is intended to assure our compliance with this Act and reaffirm our commitment to a drug-free workplace:

1. The unlawful manufacture, distribution, dispensation, possession, or use of illegal drugs is prohibited in the workplace, and a violation of any such prohibition will result in disciplinary action up to and including termination.
2. The Employee Assistance Program is available to provide help to those with a drug or drug-related problem.
3. The Act requires that an employee notify the employer of any criminal drug statute conviction for a violation occurring in the workplace not later than five days after such conviction. The employer is then required to notify the granting or contracting agency within ten days after receiving notice of the conviction.
4. An employee convicted as described above will be required, unless employment is terminated, to participate in the Employee Assistance Program or some other appropriate drug abuse assistance or rehabilitation program.

kj:37:44

SECTION II: GENERAL

A. LIMITATIONS: The rates in this Agreement are subject to any statutory or administrative limitations and apply to a given grant, contract or other agreement only to the extent that funds are available. Acceptance of the rates is subject to the following conditions: (1) Only costs incurred by the organization were included in its indirect cost pool as finally accepted; such costs are legal obligations of the organization and are allowable under the governing cost principles; (2) The same costs that have been treated as indirect costs are not claimed as direct costs; (3) Similar types of costs have been accorded consistent accounting treatment; and (4) The information provided by the organization which was used to establish the rates is not later found to be materially incomplete or inaccurate.

B. ACCOUNTING CHANGES: If a fixed or predetermined rate is in this Agreement, it is based on the accounting system purported by the organization to be in effect during the Agreement period. Changes to the method of accounting for costs which affect the amount of reimbursement resulting from the use of this Agreement require prior approval of the authorized representative of the cognizant agency. Such changes include, but are not limited to, changes in the charging of a particular type of cost from indirect to direct. Failure to obtain approval may result in cost disallowances.

C. FIXED RATES: If a fixed rate is in this Agreement, it is based on an estimate of the costs for the period covered by the rate. When the actual costs for this period are determined, an adjustment will be made to a rate of a future year(s) to compensate for the difference between the costs used to establish the fixed rate and actual costs.

D. USE BY OTHER FEDERAL AGENCIES: The rates in this Agreement were approved in accordance with the authority in Office of Management and Budget Circular A-122, A-21 or HHS Hospital Cost Principles, as appropriate, and should be applied to grants, contracts and other agreements covered by the appropriate regulation, subject to any limitations in A above. The organization may provide copies of this Agreement to other Federal Agencies to give them early notification of this Agreement.

BY THE ORGANIZATION

UNIVERSITY OF NEVADA-RENO

(ORGANIZATION)

(Signature)

JOSEPH N. CROWLEY

(Name)

PRESIDENT

(Title)

October 19, 1990

(Date)

(NP-CU-H)

BY THE COGNIZANT AGENCY

ON BEHALF OF THE FEDERAL GOVERNMENT

DEPARTMENT OF HEALTH AND HUMAN SERVICES

(Agency)

(Signature)

David S. Low

(Name)

Director, Division of Cost Allocation

(Title)

October 11, 1990

(Date)

HHS Representative Charles L. Travis

Telephone: (415) 556-1704

RATE AGREEMENT
COLLEGES AND UNIVERSITIES

UNIVERSITY OF NEVADA, RENO
CLARK ADMINISTRATION BUILDING
RENO, NV 89557-0025

DATE: 10/11/90
FILING REF.: The preced-
ing agreement was dated:
09/23/90 U50228.89

The rates approved in this agreement are for use on grants, contracts and other agreements with the Federal Government, subject to the conditions contained in Section II.

SECTION I : RATES

<u>Type</u>	<u>Effective Period</u>		<u>Rate</u>	<u>Location</u>	<u>Applicable to</u>
	<u>From</u>	<u>To</u>			
<u>INDIRECT COST RATES*</u>					
Pred.	07/01/90	06/30/93	48.00%	ON-CAMPUS	RESEARCH
Pred.	07/01/90	06/30/93	29.70%	OFF-CAMPUS	RESEARCH
Pred.	07/01/90	06/30/93	50.00%	ON-CAMPUS	INSTRUCTION
Pred.	07/01/90	06/30/93	33.00%	OFF-CAMPUS	INSTRUCTION
Pred.	07/01/90	06/30/93	24.20%	ON-CAMPUS	OTHER SPONSORED ACTIVITIES
Pred.	07/01/90	06/30/93	20.10%	OFF-CAMPUS	OTHER SPONSORED ACTIVITIES
Pred.	07/01/90	06/30/93	16.70%	ON-CAMPUS	SNJCC
Nov.	07/01/93	06/30/95		(Same rates as	cited above.)

*BASE: Modified total direct costs consisting of salaries and wages, fringe benefits, materials and supplies, services, travel, and subgrants and subcontracts up to \$25,000 each.

TREATMENT OF PAID ABSENCES

Vacation, holiday, sick leave pay and other paid absences are included in salaries and wages and are charged to Federal projects as part of the normal charge for salaries and wages. Separate charges for the cost of these absences are not made.

TREATMENT OF OTHER FRINGE BENEFITS

This organization charges the actual cost of each fringe benefit direct to Federal projects. However, it uses a fringe benefit rate which is applied to salaries and wages in budgeting fringe benefit cost under project proposals. The following fringe benefits are treated as direct costs:
STATE RETIREMENT, HEALTH INSURANCE, UNEMPLOYMENT COMPENSATION AND NEVADA INDUSTRIAL INSURANCE.

ASSURANCES

As the duly authorized representative of the applicant, I certify that the applicant:

1. Has the legal authority to apply for Federal assistance, and the institutional, managerial and financial capabilities (including funds sufficient to pay the non-Federal share of project costs) to ensure proper planning, management and completion of the project described in this application.
2. Will give the awarding agency, the Comptroller General of the United States, and if appropriate, the State, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to the award; and will establish a proper accounting system in accordance with generally accepted accounting standards or agency directives.
3. Will establish safeguards to prohibit employees from using their positions for a purpose that constitutes or presents the appearance of personal or organizational conflict of interest, or personal gain.
4. Will initiate and complete the work within the applicable time frame after receipt of approval of the awarding agency.
5. Will comply with the Intergovernmental Personnel Act of 1970 (42 U.S.C. Sections 4728-4763) relating to prescribed standards for merit systems for programs funded under one of the 19 statutes or regulations specified in Appendix A of GPM's Standards for a Merit System of Personnel Administration (5 CFR 900, Subpart F).
6. Will comply with all Federal statutes relating to nondiscrimination. These include but are not limited to: (a) Title VI of the Civil Rights Act of 1976 (P.L. 88-352), which prohibits discrimination on the basis of race, color or national origin; (b) Title IX of the Education Amendments of 1972, as amended (20 U.S.C. Sections 1681-1683, and 1685-1686), which prohibits discrimination on the basis of sex; (c) Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. Section 794), which prohibits discrimination on the basis of handicaps; (d) the Age Discrimination Act of 1975, as amended (42 U.S.C. Sections 6101-6107), which prohibits discrimination on the basis of age; (e) the Drug Abuse Office and Treatment Act of 1972 (P.L. 92-255), as amended, relating to nondiscrimination on the basis of drug abuse; (f) the Comprehensive Alcohol Abuse and Alcoholism Prevention, Treatment and Rehabilitation Act of 1973 (P.L. 91-616), as amended, relating to nondiscrimination on the basis of alcohol abuse or alcoholism; (g) Sections 523 and 527 of the Public Health Service Act of 1912 (U.S.C. 290 dd-3 and 290 ee-3), as amended, relating to confidentiality of alcohol and drug abuse patient records; (h) Title VIII of the Civil Rights Act of 1968 (42 U.S.C. Section 3601 et seq.), as amended, relating to nondiscrimination in the sale, rental or financing of housing; (i) any other nondiscrimination provisions in the specific statute(s) under which application for Federal assistance is being made; and (j) the requirements of any other nondiscrimination statute(s) which may apply to the application.
7. Will comply, or has already complied, with the requirements of Titles II and III of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (P.L. 91-646), which provide for fair and equitable treatment of persons displaced or whose property is acquired as a result of Federal or federally assisted programs. These requirements apply to all interests in real property acquired for project purposes regardless of Federal participation in purchases.
8. Will comply with the Hatch Act which limits the political activity of employees, unless the applicant is exempt.
[] Check if exempt under 5 CFR 151.101(d)(2).
9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. Sections 276a to 276a-7), the Copeland Act (40 U.S.C. Section 276c and 18 U.S.C. Section 874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. Sections 327-333), regarding labor standards for federally assisted construction subagreements.
10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234), which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is \$10,000 or more.
11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) Institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. Sections 1451 et seq.); (f) conformity of Federal actions to State (Clear Air) Implementation Plans under Section 175(c) of the Clear Air Act of 1955, as amended (42 U.S.C. Section 7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).
12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. Sections 1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers systems.
13. Will assist the awarding agency in assuring compliance with Section 103 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. 470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. 469a-1 et seq.).
14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.
15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. 2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

ASSURANCES

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. Section 4801 et seq.), which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act of 1994.

18. Will comply with all applicable requirements of all other Federal laws, EO's, regulations and policies governing this program.

19. Certification Regarding Debarment, Suspension, and Other Responsibility Matters. (a) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals: (1) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency; (2) have not within a 3-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property; (3) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph (a)(2) of this certification; and (4) have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

(b) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

20. Will comply with Sec. 622.(a) of the fiscal year 1989 Appropriations Act which requires that a Federal award recipient certify that it has in place and will continue to administer in good faith a written policy, adopted by such recipient, contractor, or party's board of directors or other governing authority, satisfactory to the head of the agency, designed to ensure that all of the workplaces of such recipient, contractor, or party are free from the illegal use, possession, or distribution of controlled substances (as defined in the Controlled Substances Act) by the officers and employees of such recipient, contractor or party.

21. Certification Regarding Lobbying. The undersigned certifies, to the best of his or her knowledge and belief, that: (a) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal contract, grant, loan, or cooperative agreement.

(b) If any funds other than Federal appropriated funds have been paid or will be paid to any person to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(c) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.



Signature

Kenneth W. Hunter, Associate Vice President for Research

Typed name and title

Board of Regents, University of Nevada System

Applicant/Recipient